Marine Safety Solutions (NZ) LTD

137 Vickerman Street | Level 2 | Sanford Building | PO Box 5022 | Port Nelson | New Zealand
Ph (03) 548 0937 | Fax (03) 548 0751 | contactus@marinesafety.co.nz | www.marinesafety.co.nz

Safe Lead Impact Study

Impact comparisons between SLL snoods fitted with Safe leads, weighted swivels & no line weighting

Marine Safety Solutions (NZ) Ltd, Client Report
Safe lead Impact: DoC April 2008

Contents

[Safe Lead; 100kg line break, imbedded with some force into the polystyrene target]

1. Executive Summary

Line weighting the snood (traditionally with lead clips or weighted swivels) increases the sink rate of the baited hook, making it more difficult for seabirds to dive on the bait, and has proven to be an effective seabird mitigation measure. However, under certain circumstances these weights can become a major safety hazard. When fisherman are pulling in a large fish the snood can break or the hook can pull out of the fish under tension, resulting in the hook and weight flying back at the boat with significant force and speed. Many fisherman in New Zealand stopped line weighting after a fatality occurred in 1996 and other serious injuries were reported during the mid to late 1990's.

The Safe lead is a new device designed and marketed by Fishtek in the UK. The Safe lead is comprised of a rubber center section sandwiched together between two lead clips, held together under tension by two O-rings. The nylon line of the snood is threaded through the Safe lead, which squeezes tight on the line. During a line break (bite off) the velocity of the nylon line recoil is far greater than the grip of the Safe lead on the line and the nylon line passes through the Safe lead allowing it to fall to the water, short of the vessel and its crew. The secondary feature of the Safe lead occurs during hook release As the hook recoils towards the vessel, the Safe lead moves away down the snood towards the hook and dampens the energy imparted to the recoiling line and hook, and reduces the force of any impact.

This trial tested the safety of Safe leads when compared with weighted swivels which are currently the preferred line weighting device used in New Zealand. This port trial was designed to simulate actual fishing use, replicating the snood design used by commercial fisherman, the angle of pull, and the amount of tension applied at sea. The trial also aimed to develop safety recommendations listing the hazards and recommended control measures for fisherman using line weighting devices.

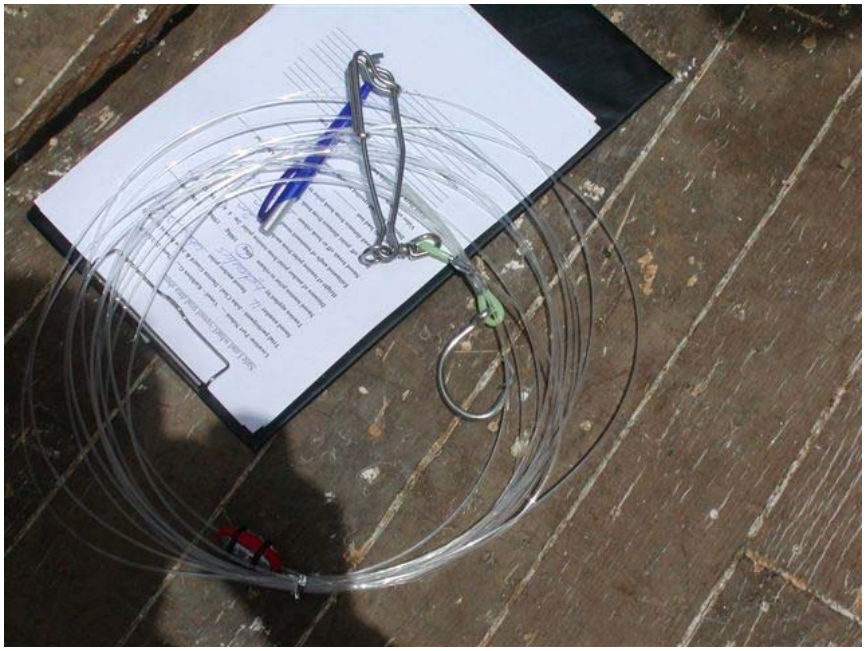
The Safe lead penetrated the target 30% less in the 100kg tension hook release trials and 45% less in the 50kg trials. In all 7 safe lead line break trials the safe lead left the line. Safe leads appear to reduce the risk of serious injury to fisherman in comparison with weighted swivels but this does not mean they are completely safe. One area of concern is that the Safe lead still is not 100% successful in reducing the probability of harm during a line break (bite off) when the safe lead is supposed to fall 'safely' and not recoil back to the vessel with force. During a previous set of trials one Safe lead did not leave the line and hit the vessel with significant force. In this trial one Safe lead that did leave the line still carried back to the vessel with enough force to cause a serious injury. As with other devices or equipment used on fishing vessels if used incorrectly or without proper controls in place the risk of an accident or serious harm injury occurring are greatly increased.

Safe leads should be recorded on the vessel hazard register if used and controls put in place with regard to crew awareness, reducing the tension applied to snoods, lowering the impact level to reduce recoils of snoods at head height, as well as and having appropriate protective equipment available. Safety recommendations have been included as part of this report, as advice for fishermen intended to reduce the risk of injuries associated with weighted snoods.

2. Surface long Line Fishery & Fishing Practices

During the late 1980s a surface longline (SLL) fishery was established off NZ's North Island East Coast, targeting several tuna species and swordfish between 20 and 150 nautical miles off the NZ Coast in approx 1000 to 3000 metres of water.

The SLL gear is deployed in a single length of up to 25nm consisting of 3 to 4mm nylon monofilament backbone supported by floats. Long 2mm nylon monofilament droppers (snoods) are clipped onto the backbone and reach depths of 100 to 400m – depending on the target species. [Appendix 6.4, SLL fishing gear assembly]



[Picture of Snood]

2.1 Seabirds & line weighting

While there are many private operators in the fishery there are also some larger domestic vessels and some larger foreign "charter" vessels that enter the fishery on a seasonal basis. The fleet was fragmented and in the past had many new operators starting fishing operations. There has not been a strong industry body which represented all fishermen, and consequently the management of environmental issues has been difficult to get out to all those out on the water.

In 2006 there were observered instances of seabird captures, some with multiple numbers of albatrosses. The Minister of Fisheries acted to mitigate against this by stopping daylight setting.

Recent new fisheries control measures introduced by the Minister will allow day fishing, only if line-weighting measures are to be carried out. For those fisherman who have not used line weighting before this will reintroduce a risk that they have not experienced previously to their fishing operations. Others that are fully aware of the risks associated with line weighting and had moved weights closer to the backbone so the weights could not recoil with any force are now finding themselves placing the weight back down the snood towards the hook. As a consequence the force and speed of any recoil from a line break will increase markedly.

Maritime New Zealand (MNZ) released a safety notice in 1996 [appendix 6.5, MNZ Notice] after the accident which caused a fatality through the use of weighted swivels. While it does act to remind fisherman of the hazards, many of the recommendations are not practical and could not be applied during normal fishing operations. This notice would form the basis for any future investigation of similar accidents, and harsher penalties may apply if best practice does not reflect its recommendations.

2.2 Surface longline, Gazette Notice-2008 (F429)

The Notice comes into force the day after the date of its notification in the NZ Gazette.
Trip notification to take Tuna or Swordfish in the EEZ requires 5 days notice. Vessels must carry an approved seabird-scaring device (approved tori line). No fishing from ½ hour before dawn and ½ hour after dusk unless line weighting is deployed by adding 45gms or more to every hook.

- Weights less than 60gm must be within 1m of the hook
- Weights of 60-98gm must be within 3.5m of hook
- Weights < 98gms must be within 4m of the hook

[This is only a general summary of the gazette notice; refer to the original gazette notice for full wording].

3. Safelead Impact Trial Design

- The aim was to quantify the force of any fishing gear propelled back towards the fishing vessel when snood lines are broken or released, at different weighting and line tensions, in order to understand the safety risks posed by Safe leads, in comparison to using weighted swivels or no weights, in a traditional pelagic longline fishing environment, and produce a safety management plan for their use by commercial fishers.
- The trials were conducted under a realistic controlled simulation of fishing practice, using a fishing vessel in port.
- All factors other than the weighting regime used on the snood were kept constant (including angle of snood to vessel, snood length, relative position of weight on snood, and all snood materials other than the weights). All materials, other than weights, were those most commonly used by commercial pelagic longline fishers in New Zealand.

- Snoods were 12 m in length, the weighted swivels were 60g & safe leads were 68 g in weight. Weights were applied 2 m from the hook (this is the mid-point of recent seabird mitigation standards for line weighting).
- A large 12 m floating barge/wharf platform was used allowing the vessel to tie up and move with the tide, so that the breaking angle remained constant for all trials. This allowed for the same distance between the tie off point and the vessel each time, meaning all snoods could be broken off at the same point.
- The hauling angle replicated commercial fishing. The snap off and hook release angle propelled the line towards a double polystyrene screen on wooden backing boards (approximately 90% hit rate on the screen expected) placed beneath the gantry net roller, which was used to pull the snoods.
- The impact of fishing gear (i.e., Safelead, weighted swivel or hook) was measured by measuring the depth of impact of the gear into the polystyrene sheeting. Data on how far the safe lead travelled down the snood during the re-coil were also captured.
- Fifty trials were attempted as per the experimental design below:

Number of snoods to trial at each tension	First 30	31-40	41-50
Line break at 200kg with SafeLead	5		
Line break at 200kg with weighted swivel	5		
Line break at 100kg with SafeLead	5		2
Line break at 100kg with weighted swivel	5		2
Hook release at 100kg with no weights		3	
Hook release at 100kg with SafeLead		4	
Hook release at 100kg with weighted swivel		3	
Hook release at 50kg with no weights	3		2
Hook release at 50kg with SafeLead	4		2
Hook release at 50kg with weighted swivel	3		2

[Actual size of a 68g safe lead & 60g weighted swivel]

4. Line Breaking Procedures

The fishing vessel Kathleen G was used for the trials. The vessel used its net roller for the hydraulic power to pull the snoods to the required tension. 2 x 150mm thick polystyrene sheets were clamped together on the vessels deck to provide the impact zone/target for the trials. [Appendix 6.1, Jetty & vessel layout]

The floating jetty provided an excellent platform to use for the anchor point. The tension meter (large set of scales) attached to the jetty walkway, allowed all snoods to have equal tension applied. After each trial, all snood parts were placed in a bag, photos taken, and measurements made.

All involved received a full safety briefing, covering the hazard analysis, before the commencement of the trials. Each of the four-member team where given set, fixed safe locations for each trial. The jetty, with only one access point, was locked for the duration of the trials, which gave a safe isolated environment to carry out the trials. Personal protective equipment was worn by all members involed when required.

The tension point was anchored to the jetty. The tension meter had a rope release line fixed, and the snood was attached to this. The tension meter allowed for preset breaking strains to be applied for each trial.

For the line breaks the snood was cut by a knife on a 3m pole just in front of the hook, allowing the nylon and or weight to recoil back to the vessel. For the hook release trials a rope loop was attached to the tension meter then the hook attached to this loop. The rope was cut at the correct tension allowing the hook and weight to recoil back to the vessel.

The vessel skipper operated the hydraulic net roller system, and along with the crew tied the snood to the net roller and measured the impact zones. After each trial the crew placed all the snood parts in a bag marked with the number of the trial, so further examination of all parts could be done at a later date. Each snood was wet and the position of the swivel/safelead measured to ensure all were fixed at 2m from the hook. [Appendix 6.2 snood specification]

The two managers from Marine Safety Solutions completed the data-recording sheets, set the tension meter, broke/cut off all trials and took video footage and photographic evidence of each trial. [Appendix 6.3 recoding sheet] All snoods were broken off at 8.0m from the target/polystyrene sheet; there is considerable stretch in a snood and an 8m line was drawn on the jetty for reference.

The snood was attached to a rope line to connect it with the net roller, then run under a 80mm galvanised pipe which allowed the snood line to be kept at the correct height just over the polystyrene sheets. Initially this proved not to be totally successful and the strike rate was only 80%. This method was changed after the 18th snood and using a hand saw

individual groves, 300mm deep, were cut into the polystyrene for each trial. This allowed for 100% strike rate.

[Tension meter with safe lead snood ready to cut & hit the target]

The same angle of attack was used for all snood trials; 20 degrees (the approximate angle from the pipe rail under the net roller to the tension meter). This represented a similar angle to the deck of a vessel landing fish.

The construction of the 12 m snood was the same as generally used by commercial fisherman. [Appendix 6.2 snood specification]

Each impact on the target was labelled in permanent marker on the polystyrene with the number of the snood, the depth and width of the weight impact and depth of the hook impact.

All information was also added to the recording sheets including comments on gear performance, if the safe lead or weighted swivel hit the target and if not where all parts of the gear ended up.

5. Summary of Data Gathered & General Observations

A total of 49 snoods were trialed:

- 34 trials were successful with 30 hitting the target leaving measurable impacts. The 4 other trials were safe lead line breaks, which successfully left the line and fell short of the target.
- Snoods 18, 24, 41 & 45 were discounted, due to gear failure.
- Snoods 1 to 10 were also discounted; these were the 200 kg trials.
- Snood 11 was cut by mistake and also discounted

The 200 kg line breaks have not been included in the final data summary sheet. These snoods all failed below the 200kg breaking tension, all breaking between 130 and 170 kg. While the nylon line has a 200 kg breaking strain once crimped its strength has became greatly reduced.

Gear failed on 4 trials; on one the crimp let go at 50kg, on another the nylon broke when catching on a sharp piece of the galvanised pipe, and on the other two the weight completely missed the target. All were discounted.

Several weighted swivels missed the target/polystyrene sheet, with only a 80% strike rate for the first 18 snoods tested. Most of these trials were the 200kg snoods which also failed to break off at the correct tension.

We changed the method to ensure increased strike rates. Instead of the snood being pulled over the polystyrene sheet groves were cut with a saw from the top, down 300mm into the polystyrene sheet and a snood placed through a new grove for each trial.

Of note was the condition of the safe leads after the line breaks. Many (14 from 23) were damaged, and could not have been reused (but could have been used for spare parts).

In an earlier pilot trial, we had tested 10 safe leads. The safe leads during these earlier line breaks all stayed intact and all but one fell off the snood as per expected outcomes. The safeleads all travelled approximately 2m to 3m (depending on the tension they were cut off at). The safe leads used for this trial had new O-rings fitted (the safe lead is still a prototype product and the new O-rings were a product enhancement developed by Fishtek). During the current trials most of the safe leads were badly twisted and travelled much further (4m to 6m) before coming off. The main encouraging result with this trial was that all safe leads did leave the line (during line breaks) as per their expected design outcomes.

[Twisted safe lead after 100kg line break]

We assume from this information that the new O-rings supplied for this trial had more grip and held the safe lead on the snood with more force. All the safe leads fell from the line as they were supposed to, but many of them were damaged, with the red rubber centre being ripped in some cases. Many ended up twisted and out of shape but most could be reassembled.

Acknowledgment

Thanks to

- Fishermen, Dale Coker & Dave Kellian for commercial fishing advice
- Skipper, Alan Basaiji & crew, Tony Hana of the FV. Kathleen G
- Diverse Engineering, for providing the jetty

Summary of results

Trial type	Type of weight	Tension	Number of snoods	Average movement of Safe lead	Average depth of weight impact (mm)	Average depth of hook impact (mm)	Average width of weight impact (mm)
Hook release	No weight	100kg	4	-	-	212	-
Hook release	No weight	50kg	3	-	-	128	-
Line break	Swivel	100kg	7	-	213	-	80
Hook release	Swivel	100kg	3	-	211	156	90
Hook release	Swivel	50kg	3	-	135	110	83
Line break	Safe lead	100kg	7	All came off	17*	-	26
Hook release	Safe lead	100kg	4	105	147	56	43
Hook release	Safe lead	50kg	3	79	73	18	41

*Average depth of impact for the three Safe leads that hit the target after leaving the line

Data Summary

Hook release at 100kg

The safe lead average impact depth was on average 64mm less than the weighted swivel
The Safe lead penetrated the target 30% less than the weighted swivel
The safe lead hook penetrated the target 64% less than that of the weighted swivel hook
The safe lead travelled down the snood on average 1050mm during the recoil

Hook release at 50kg

The safe lead average impact depth was 62mm less than the weighted swivel
The Safe lead penetrated the target 45% less than the weighted swivel
The Safe lead hook penetrated the target 38% less than that of the weighted swivel hook
The safe lead travelled down the snood on average 787mm during the recoil

Hook release (no weight) at 50kg & 100kg

Weight of hook & crimp only was 28g
The snoods with no weights had significant recoil and impact.
The 100kg tension hook release impact depth averaged 212mm
The 50kg tension hook release impact depth averaged 128mm
The hooks of snoods with no weights penetrated the target 20 to 30 % less than the hooks of weighted snoods. Note, the safe lead snoods at 100 kg reduced the hook impact greatly compared to the 50kg snoods

Line breaks at 100kgs

All 7 weighted swivels trialed hit the target, 3 of the 5 safe leads hit the target
Two of the safe leads did not hit the target and travelled approximately 6m towards the vessel. Two of the safe leads only just hit the target leaving 2 or 3 mm depth impact marks
One safe lead did hit the target leaving a 50mm impact mark. The safe lead did leave the nylon snood but for some reason it had enough force to travel forward and leave a reasonable impark mark on the target.
The safe lead impact depth was on average 196mm less than the weighted swivel
When safe leads did hit the target, they penetrated the target 92% less than the weighted swivel

Appendix 6.0 Safety recommendations for line weighting snoods

Background

The practice of weighting snoods to reduce gear tangling & reduce the risk of seabird captures has been carried out for a number of years. Placing a weight between the hook and snood was common practice in the 1990's until a fatality and several major injuries from recoiling weights occurred. MNZ released a safety notice on the hazards associated with this procedure [Ref-Boat Notice-07/1996 May]. Many surface long line fishers have since stopped using this method or have placed the weight much closer to the backbone to stop the risk of impact to crew

Currently

New seabird mitigation regulations for surface long lining only allow for daytime setting if line weighting is carried out to prescribed requirements. [Ref-Gazette Notice 2008-F429]

Hazards with line weighting

During a bite off/line break or hook release under tension the weight becomes a dangerous projectile recoiling with speed & force towards the vessel. The first point of impact is in the proximity of the person or device that is applying the tension to the snood. A 65-gram weight (weighted swivel or safe lead) released with 100kg of tension recoils at approximately 450km/h. Reducing the force/tension applied to the snood will reduce the risk of harm.

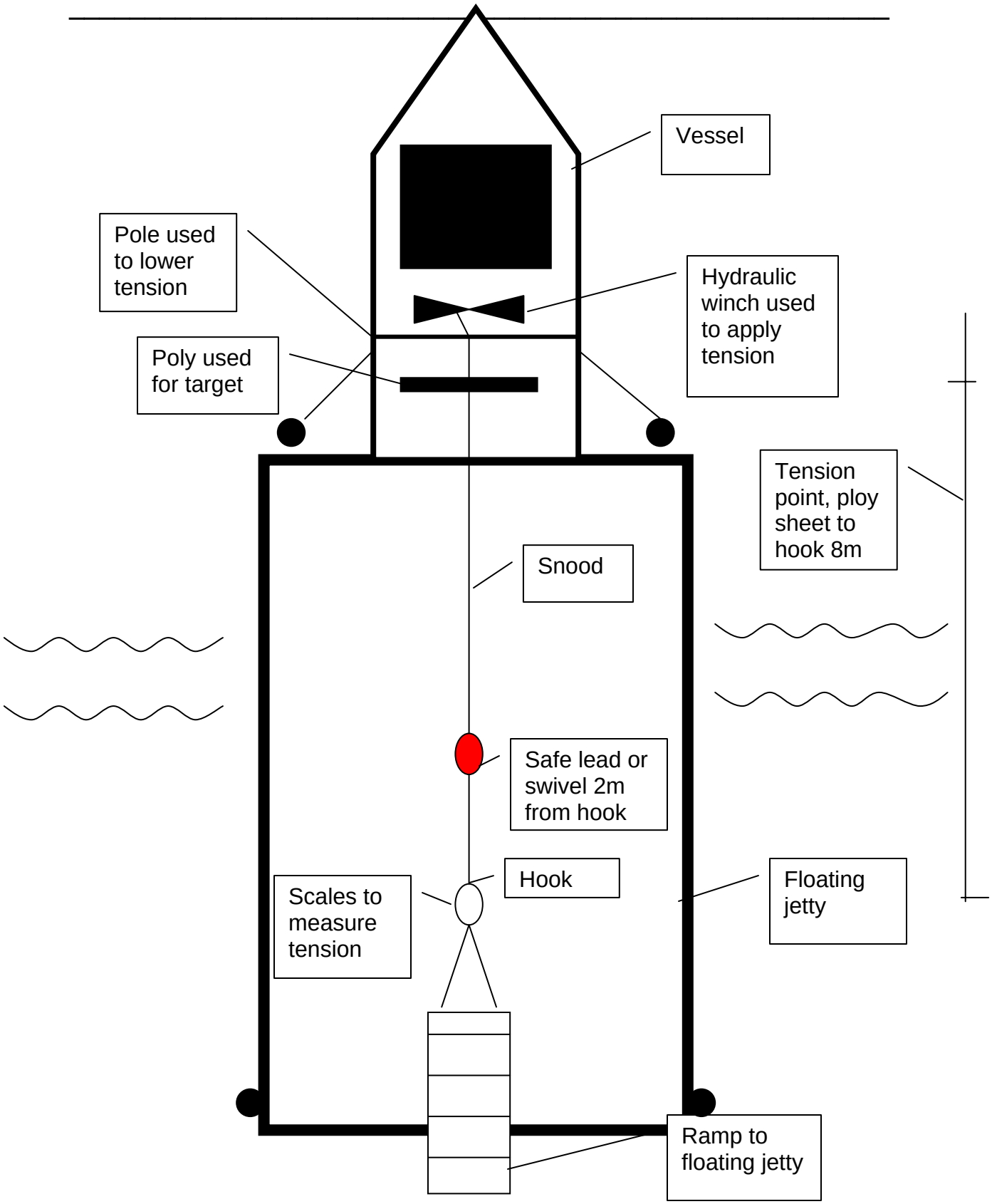
Safety recommendations when using weighted snoods

- Ensure all crew on deck are immediately made aware when a large fish/shark is on the line
- Use a fighting line to play large fish, only experienced crew should handle this line
- Hand landing of fish is recommended or set hydraulic haulers to low-pressure settings
- Locate lead blocks or pull the snood from a low position to lower the impact area/zone
- Identify the hazards in the snood handling procedures & add to the vessels SSM hazard register, ensure controls are in place to manage these hazards
- Use the correct Personal Protective Equipment. Recommended is the use of a full face visor to be worn when fighting/landing sharks & larger fish

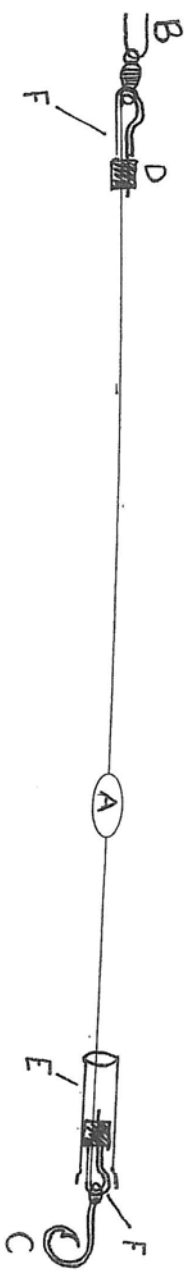
Safe Leads

Safe leads are a line-weighting device; the nylon is passed through a rubber centre with lead weights fitted to this by O-rings, allowing the device to be adjusted on the snood.
Safe leads have proven to reduce recoil impacts when compared to weighted swivels. Although significantly reduced, the recoil could still cause a serious harm injury. You should still apply all the recommendations above.
Ensure that when attaching the safe lead to the snood you allow enough travel/distance from the hook (2m is recommended) to allow the lead to slide down the line during recoil, this dampens the force of the impact.
During a bite off/line break the safe lead will travel down the line and fly off the snood (gear loss) leaving only the nylon to recoil. The cost of gear loss could become significant; placing the safe lead further up the snood towards the backbone clip will reduce gear loss.

Appendix 6.1 Jetty & vessel layout



Appendix 6.2 Snood Specifications



Standard Surface Long line Snood

A 220Kg 2.00mm Mono @ 12-14M
B Snap Tuna Swivel 3.75mm x 140
C SS TC Eagle Claw 16/0 hook
D D size aluminium crimp 2.00mm
E Light sleeve 80mm of luminous green
F Light sleeve 50mm of clear
E Safe lead

Appendix 6.3 Safe lead trial data recording form

Safe lead wharf trial recording sheet

Location: Diverse floating repair platform Port Nelson **Vessel**: Kathleen G
Date…2nd April 2008
Trial participants: John Cleal, Darren Guard, Allan Basalaj, Tony Hana

Snood number: 1……Snood tension…200 kg/snood broke at 100kg…….

Snood type (Swivel) (safe lead) (no weight) *circle one*

Trial type (hook release) or (break off) *circle one*

Snood length from tension to release point…8……..m

Safe lead & swivel attachment point from hook…2.0.m

Safe lead movement down snood after release (if attached)…fell off…m

Did the safe lead appear to reduce the impact ……yes……

Distance hook, safe lead or swivel traveled after release…4m……

Did the Safelead, swivel or hook hit the polystyrene …NA

What was area of vessel was hit and what was the impact likely to cause serious harm…safe lead fell short of vessel ……

Was there an impact mark in the polystyrene…yes/ no?

Depth of polystyrene impact mark…nil……mm…

Size of polystyrene impact mark width .….Nil…mm

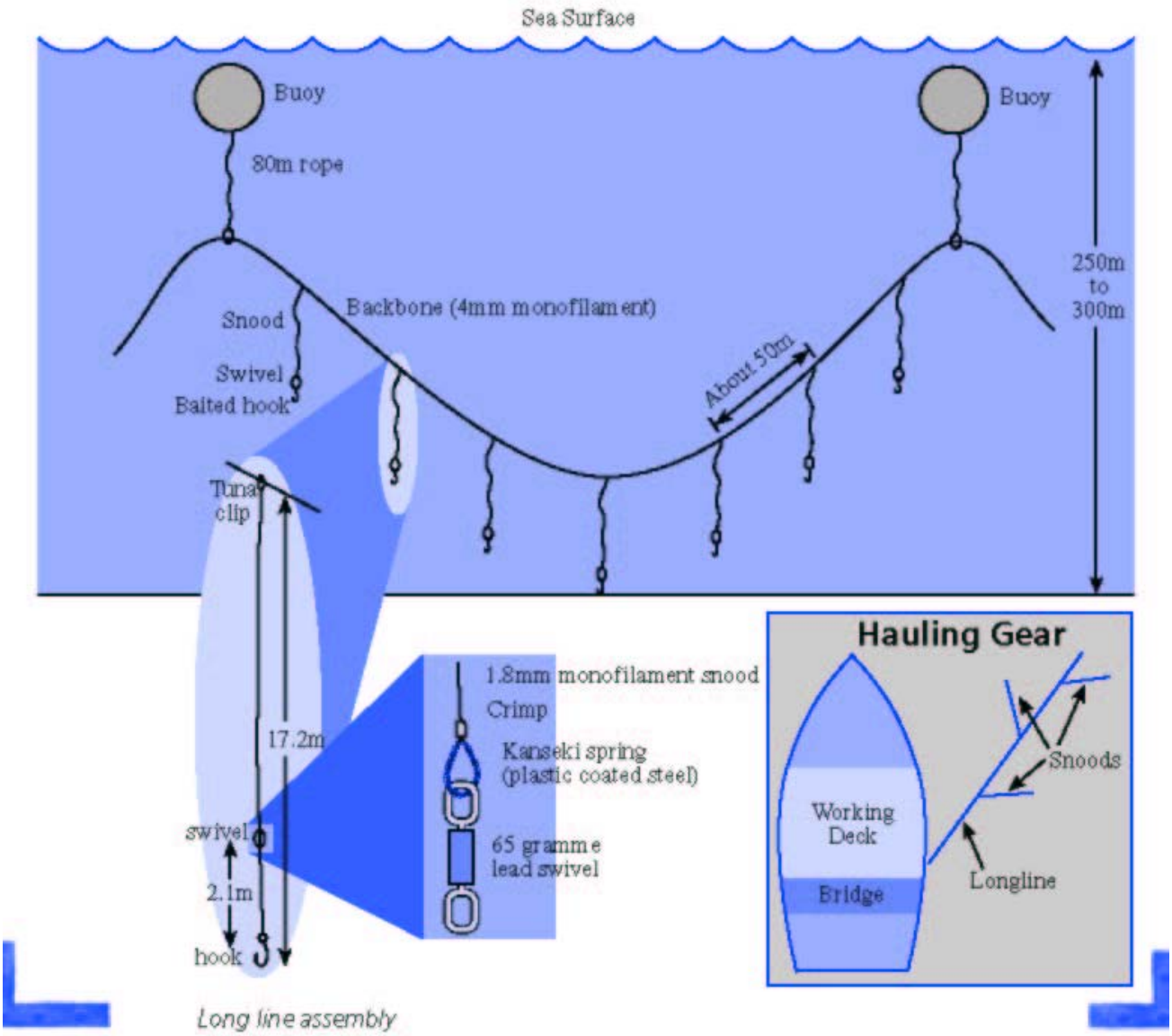
Is the impact to be significant to cause a serious harm injury.….nil……

Where there any hazards identified with this trial…NA……..……
……

Any further comments…nylon broke at crimp, at 100kg,
……
……

Appendix 6.4 Surface long line fishing gear assembly

[example of one type of gear set, this does change markedly by different skippers]



Appendix 6.5 Maritime NZ - Safety Notice

Maritime Operations

BOAT NOTICE – 07/1996 MAY

HAZARDS WITH SURFACE LONG-LINE FISHING

A fatal accident on board a fishing vessel highlights a need to alert fishermen to the dangers associated with surface longline fishing.

This method of fishing for tuna by surface long-line has been used in New Zealand since about 1989. The fishing vessel in question employed the following procedure:

A 4mm diameter monofilament long-line, called the backbone, was set to hang in the water with floats. A series of 1.8mm diameter monofilament lines, called snoods, were attached to the backbone at intervals. Hooks and swivels were attached to the snoods. The backbone was hauled in through a lead block by a hydraulic winch located on the working deck and the deckhands removed the snoods as they approached the lead block. Lead weighted swivels were used to sink the bait and keep the hooks away from the backbone.
On this particular occasion, as the long-line was hauled in, the deckhand realised a shark was hooked, called "shark on" through the intercom and paid out on the winch hauler in order to reduce the tension on the line to prevent it breaking.
However, the snood broke between the hook and the 65g lead swivel. The tension in the line projected the swivel forward and upwards, fatally striking a deckhand on the side of his head. Although a warning was given over the intercom, it could only be heard on the bridge.

Owners and skippers of vessels using similar fishing methods should make a careful assessment of the likely dangers and take all practical steps to minimise the hazard from potential projectiles such as weighted swivels. This may include the following:

• Use stainless steel wire rope between the swivels and hook to prevent damage to the line from fish bites.
• Use low stretch material for snoods
• Locate lead blocks at a low level to reduce the tendency for swivels to be projected upwards
• Provide physical protection such as guards, and keep the size of sea doors to a minimum.
• Arrange procedures to warn the crew of the presence of a shark on the line
• Ensure that the crew are aware of the hazard and take immediate action to protect them selves when a warning is given.

Appendix6.6 Raw data

Snood Number	Snood Tension	Snood Type	Trial Type	Distance recoiled after release	Was impact reduced	SL movement on snood	Was poly impacted	Was there poly impact mark	Was safe lead or swivel damaged	Depth of impact mm	Length & Depth of impact mm	Was impact significant to incur harm	Hazards identified
1	200 broke @ 100 kg	Safe lead	line break	4m	Yes	Came off snood	No	No	Yes	NA	NA	No	Nil
2	200 broke @ 120 kg	Safe lead	line break	2m	Yes	Nil,failed trial	No	No	No	NA	NA	No	Nil
3	200 broke @ 150 kg	Safe lead	line break	6m	Yes	Came off snood	No	No	Yes	NA	NA	No	Nylon recoil
4	200 crimp broke @ 50 kg	Safe lead	line break	8m	Yes	2m to hook,failed trial	Yes	Yes	No	10mm	50mm x 20mm	No	Flying lead
5	200 released @ 160 kg	Safe lead	line break	8m	Yes	2m Came off snood	No	No	Yes	NA	NA	No	Nil
6	200 crimp failure @ 170 kg	Swivel	line break	10m	NA	NA	Yes	Yes	Yes	60mm	60mm x 50mm	Yes	Flying swivel
7	200 crimp failure @ 130 kg	Swivel	line break	10m	NA	NA	Yes	Yes	Yes	150mm	50mm x 150mm	Yes	Flying swivel
8	200 crimp failure @ 150 kg	Swivel	line break	10m	NA	NA	Yes	Yes	Yes	180mm	40mm x 180mm	Yes	Hook recoiled
9	200 crimp failure @ 160 kg	Swivel	line break	10m	NA	NA	No	No	Yes	NA	NA	Yes x 2	Flying swivel
10	200 crimp failure @ 130 kg	Swivel	line break	10m	NA	NA	No	No	Yes	NA	NA	Yes	Flying swivel
11	100 cut rope by mistake	Safe lead	hook release	8m	No	1m	Yes	Yes	Yes	SL 50mm Hook 60mm		Yes	SL & hook went into poly
12	100 kg	Safe lead	line break	8m	Yes	2m	No	No	Yes	NA	NA	No	Recoiling nylon
13	100 kg	Safe lead	line break	8m	Yes	2m came off	Yes	Yes	Yes	50mm	40mm x 50mm	Yes	SL impact
14	100 kg	Safe lead	line break	8m	Yes	2m came off	Yes	Yes	Yes	1mm	20mm x 1mm	No	Nil

Snood Number	Snood Tension	Snood Type	Trial Type	Distance recoiled after release	Was impact reduced	SL movement on snood	Was poly impacted	Was there poly impact mark	Was safe lead or swivel damaged	Depth of impact mm	Length & Depth of impact mm	Was impact significant to incur harm	Hazards identified
15	100 kg	Safe lead	line break	8m	Yes	2m came off	Yes	Yes	Yes	1mm	20mm x 1mm	No	Recoiling nylon
16	100 kg	Safe lead	line break	7m	Yes	2m came off	No	No	Yes	NA	NA	No	Recoiling nylon
17	100 kg	Swivel	line break	8m	NA	NA	Yes	Yes	No	180mm	30mm x 180mm	Yes	Flying swivel
18	100 kg fail missed ploy	Swivel	line break	10m	NA	NA	No	No	No	NA	NA	Yes	Nil
19	100 kg	Swivel	line break	8m	NA	NA	Yes	Yes	No	190mm	190mm	Yes	Flying swivel
20	100 kg	Swivel	line break	8m	NA	NA	Yes	Yes	?	200mm	60mm x 200mm	Yes	Flying swivel
21	100 kg	Swivel	line break	8m	NA	NA	Yes	Yes	?	250mm	100mm x 250mm	Yes	Flying swivel
22	100 kg	Swivel	line break	8m	NA	NA	Yes	Yes	?	215mm	110mm x 215mm	Yes	Flying swivel
23	100 kg	Swivel	line break	8m	NA	NA	Yes	Yes	No	260mm	110mm x 260mm	Yes	Flying swivel
24	100 kg	No weight	hook release	8m	NA	NA	No	Yes	NA	10mm	100 x 10mm hook	?	Recoiling nylon
25	100 kg	No weight	hook release	8m	NA	NA	Yes	Yes	NA	200mm	shape x 200mm hook	Yes	Recoiling hook
26	100 kg	No weight	hook release	8m	NA	NA	Yes	Yes	NA	250mm	shape x 250mm	Yes	Recoiling hook
27	100 kg	No weight	hook release	8m	NA	NA	Yes	Yes	NA	180mm	60mm x 180mm	Yes	Recoiling hook
28	100 kg	Safe lead	hook release	8m	maybe	1m then back 450	Yes	Yes	No	170mm	55mm x 170mm	Yes	Flying hook & safe lead
29	100 kg	Safe lead	hook release	8m	Yes	800mm	Yes	Yes	Yes	140SL, 50hook	50mm x 140mm sl	Yes	Flying hook & safe lead

Snood Number	Snood Tension	Snood Type	Trial Type	Distance recoiled after release	Was impact reduced	SL movement on snood	Was poly impacted	Was there poly impact mark	Was safe lead or swivel damaged	Depth of impact mm	Length & Depth of impact mm	Was impact significant to incur harm	Hazards identified
30	100 kg	Safe lead	hook release	8m	Yes	1.2m	Yes	Yes	Yes	160SL, 75hook	30mm x 160mm sl	Yes	Flying hook & safe lead
31	100 kg	Safe lead	hook release	8m	Yes	1.2m	Yes	Yes	Yes	160SL, 50hook	40mm x 120mm sl	Yes	Flying hook & safe lead
32	100 kg	Swivel	hook release	8m	NA	NA	Yes	Yes	No	205SW, 130hook	100mm x 205mm sw	Yes	Recoiling hook & swivel
33	100 kg	Swivel	hook release	8m	NA	NA	Yes	Yes	No	170SW, 158hook	80mm x 170mm sw	Yes	Recoiling hook & swivel
34	100 kg	Swivel	hook release	8m	NA	NA	Yes	Yes	No	260SW, 180hook	90mm x 260mm sw	Yes	Recoiling hook & swivel
35	50 kg	No weight	hook release	8m	NA	NA	Yes	Yes	No	135mm	80mm x 135mm	Yes	Recoiling hook
36	50 kg	No weight	hook release	8m	NA	NA	Yes	Yes	No	140mm	80mm x 140mm	Yes	Recoiling hook
37	50 kg	No weight	hook release	8m	NA	NA	Yes	Yes	No	110mm	70mm x 110mm	Yes	Recoiling hook
38	50 kg	Safe lead	hook release	8m	Yes	1m	Yes	Yes	No	35SL, 5hook	40mm x 35mm	No	NA
39	50 kg	Safe lead	hook release	8m	Yes	700mm	Yes	Yes	No	105SL, 20hook	45mm x 105mm	No	NA
40	50 kg	Safe lead	hook release	8m	Yes	500mm	Yes	Yes	Yes	80SL, 30hook	40mm x 80mm	No	NA
41	50 kg	Safe lead	hook release	8m	Yes	950mm	Yes	Yes	Yes	30mm	30mm hook only	Yes	Hook recoiled
42	50 kg	Swivel	hook release	8m	NA	NA	Yes	Yes	No	140s, 120hook	90mm x 140mm	Yes	Recoiling hook & swivel
43	50 kg	Swivel	hook release	8m	NA	NA	Yes	Yes	No	135mm	80mm x 135mm	Yes	Recoiling hook & swivel

Snood Number	Snood Tension	Snood Type	Trial Type	Distance recoiled after release	Was impact reduced	SL movement on snood	Was poly impacted	Was there poly impact mark	Was safe lead or swivel damaged	Depth of impact mm	Length & Depth of impact mm	Was impact significant to incur harm	Hazards identified
44	50 kg 150 kg	Swivel	hook release	8m	NA	NA	Yes	Yes	?	130s, 100hook	80mm x 130mm	Yes	Recoiling hook & swivel
45	Nylon failure	Safe lead	line break	-	-	-	-	-	-	-	-	-	-
46	100 kg	Safe lead	line break	4m	Yes	Fell off 2m	No	Yes	gone	20mm nylon	80mm x 20mm n	No	NA
47	100 kg	Swivel	line break	8m	NA	NA	Yes	Yes	No	200mm	70mm x 200mm s	Yes	Recoiling swivel
48	100 kg	Safe lead	line break	-	Yes	Came off 2m	No	Yes	Yes	20mm nylon	50mm x 20mm	No	Nylon recoil
49	100 kg	No weight	hook release	8m	NA	NA	Yes	Yes	?	220 hook only	55mm x 220mm	Yes	Recoiling hook

Snood Number	Comments
1	Gear failure at 100kg but SL did its job well and just fell off nylon
2	Nylon broke 2m from SL, nylon damaged, do not count!
3	Gear failure, SL flew to bits and came off line
4	Crimp failed at 50kg and SL flew to boat but stayed on snood due to crimp staying on line
5	SL flew to back of boat & fell of snood & flew to bits
6	Serious recoil just hit the top of the poly, need to bring firing line closer to the poly, top of exhaust stack, denting metal, lodged in stack
7	Swivel impacted poly and hook flew backwards toward cutting point
8	Same as above
9	Hook flew towards scales 4m, swivel clipped the top of poly& stuck into freezer hatch 6mmplastic sheet then also went 60mm into hatch insulation Scary impact
10	Swivel recoil very dangerous missed poly again time to change impact point around
11	Both leads on SL dug into poly, was meant to be a line break but ended up hook release.
12	Worked well SL flew to bits but no impact
13	Impact would have caused harm, impact 50mm, SL did not fall from nylon as meant to, SL damaged but reusable
14	SL worked well just falling short of the poly & coming off the snood all OK
15	SL worked OK, only just touched poly on impact ie 2mm, SL came off snood as required
16	Crimp & hook released @ 100kg but result same as bite off @ 100, SL came off snood as required
17	Snood remained in good condition minus cut off hook a good impact on poly
18	Swivel clipped poly & went through hole that was cut for nylon but still a significant recoil
19	Weight went through existing hole so impact was greater than it could have been
20	Good hit, very serious impact
21	Good hit, very serious impact
22	Good hit, very serious impact
23	Good hit, very serious impact
24	The line cut (gear failure) so no hook recoil, but nylon went in 10mm .Surprising damage from just nylon recoiling.
25	Hook recoil similar to weighted swivel
26	Serious recoil, could cause significant injury
27	Serious recoil, not as hard as prior
28	SL moved 1m towards hook then on poly impact moved back 500 toward snood end leaving red on the nylon. Hook & SL impacted
29	SL & hook both impacted into poly both with significant force (hook impacted 150mm away in 50mm)

Snood Number	Comments
30	Similar to snood 28, we think the SL moved 1200 then got pushed back 300 when hitting poly
31	Hook & SL impacted in stuck in poly possible 1200 movement at release and 400 back on poly impact
32	Hook & swivel had large impact could have caused significant injury
33	Hook & swivel stuck into poly generally hook and swivel both go in with force
34	Recoiling hooks & swivels very severe impacts
35	No weight at 50kg still a significant impact of hook
36	Hook stuck to poly still significant
37	Still significant although less than 100 & 150kg
38	Safe lead seemed to dampen recoil
39	Safe lead seemed to work and dampen blow
40	Still impact damage but not serious harm
41	Hook only dug into poly, SL missed and had no impact, still a reasonable force
42	Hook & swivel dug in with significant force
43	Swivel only hit not hook
44	Dangerous stuff
45	-
46	Nylon recoiled SL gone came off line all worked as should do
47	Severe impact of swivel
48	Only recoiling nylon, not too bad
49	Quite dangerous